Biographical Article

Doris Howes Calloway (1923–2001)

Janet C. King

U.S. Department of Agriculture/ARS Western Human Nutrition Research Center, University of California, Davis, CA 95616

Doris Howes Calloway died August 31, 2001, in Seattle, WA, after a long battle with Parkinson's disease. She was born February 14, 1923, in Canton, OH. Her father, Earl Howes, was a lawyer, judge, and fingerprint and ballistics expert. He died when Doris was 3 years old. To support Doris and her older sister, June, Doris's mother, Lillian Roberts, worked as a Pinkerton's undercover agent, specializing in fraud. Doris commented once that with both parents being private investigators, she may have inherited her skills of observation and inquiry. Doris and her sister, June, both took ballet lessons and learned to tap dance. Doris maintained an interest in music, dance and the arts throughout her life, and she enjoyed the San Francisco Symphony and the Opera.

As a child, Doris attended public schools in East Canton, OH. Her academic excellence was evident early; she graduated as valedictorian of her high school class of 1300 students when she was only 16. Although Doris was interested in studying medicine, finances did not permit this. Instead, she won a scholarship to Ohio State University entering in the Fall of 1939. During her senior year at OSU, her mother died, leaving Doris an orphan at an early age. Doris received a B.S. in nutrition and dietetics in 1943 and was encouraged to stay at OSU to study for a Ph.D. in Physiological Chemistry. However, with World War II in progress, she wanted to do something more immediately useful, which led to her completing a dietetic internship at Johns Hopkins Hospital in Baltimore.

Doris then joined a Department of the Army research project at the University of Illinois Medical School in Chicago. The project was to study whether dietary protein and physical activity could shorten the time required for convalescence from surgery. This marked the beginning of Doris's research career in human metabolic studies. She worked with a very talented group, including Professor H. H. Mitchell, a well-known nutritional scientist who was noted for his rigor in the design and conduct of nutrition research.

While engaged in this research, Doris entered the graduate program at the University of Chicago. She also met Nathaniel Ogelsby Calloway, an intern on the wards of the hospital, and they married in 1946 on her birthday, February 14th. Their first child, David, was born while she was still a graduate student. Nevertheless, she completed her Ph.D. in Nutrition in 1947, a mere three years after she began her studies—a testimony to her academic capability and her ability to maintain a high energy focus on her activities. Candice, her second child, was born shortly after Doris finished her doctoral degree.

In 1951 Doris was appointed as a nutritionist at the Armed Forces Food and Container Institute in Chicago and was made Chief of the Nutrition Branch. Nat, her husband, had just been drafted into the Korean conflict, and they could not make ends meet on his salary alone. It was here that she discovered that there were properties in food that helped protect against radiation. She found that broccoli reduced the carcinogenic effect of radiation. In 1959 the Institute named her "Man of the Year." Doris loved the plaque and displayed it in her office throughout her career. After the war, Nat became very involved in Chicago politics. The demanding social obligations associated with the "Daly Machine" overwhelmed them, and in 1956, they were divorced.

Doris Howes Calloway

In 1961 Dr. Calloway accepted a position as Chair of the Department of Food Science and Nutrition at the Stanford Research Institute (SRI) in Menlo Park, CA. She was actively recruited by SRI in October, 1960, but decided that she did not want to leave Chicago. In January, Chicago had a major snow storm; when SRI called to see if she wanted to reconsider, she did. While with SRI, she developed the special food

0022-3166/03 $3.00 J. Nutr. 133: 2113–2116, 2003.
Manuscript received 17 December 2002.

packaging systems appropriate for space travel that are still used today. She also assisted with developing freeze-dried orange juice and putting it on board space vehicles.

In 1962 Professor George Briggs persuaded Doris to drive the 50 miles from Menlo Park to Berkeley twice a week to teach diet therapy in the Department of Nutritional Sciences at the University of California at Berkeley. In 1963, Professor Briggs recruited her to join the faculty at UC Berkeley where she spent the remainder of her life. Delroy Brown, her technician at SRI, came with her to Berkeley and assisted her in all of her studies. Professor Sheldon Margen, a physician with a strong interest in nutrition and metabolism, joined the faculty at about the same time. Together, Doris and Shelly established the "Penthouse," a facility for conducting metabolic studies in the old home management apartment in what had been designed previously as a Home Economics Department. This apartment was used to house up to six volunteers for many weeks at a time. Work in the Penthouse ended in 1977.

On July 4th 1981, Doris married Robert Nesheim, Vice-President of Science and Technology for Quaker Oats in Chicago. Doris had been an independent woman for many years; symbolically, this day was chosen to indicate that her independence was not being surrendered. Bob was active in areas of nutrition and food research, and they had served together on the Food and Nutrition Board of the National Academy of Sciences and many related committees. During the first two years, they maintained a "commuter-marriage" with Bob living in Chicago and Doris in Berkeley. In 1983, Bob retired from Quaker Oats and became President of a company in Monterey, CA, which provided a shorter commute.

Doris: the Scientist

Doris's research contributions are extensive in terms of both quantity and subject matter. In this review, her research was grouped into nine different areas (**Table 1**). The diversity of her work demonstrates her exceptional mastery of a broad spectrum of human nutrition and food science. Often she was working on two or more topics at one time. Dr. Sheldon Margen was a key collaborator in her metabolic studies of human protein requirements. At the end of her career, Dr. George Beaton worked with her on the functional consequences of malnutrition among populations in developing countries.

Her first paper, published in 1947 when she was a young dietitian working at the University of Illinois with Professor H. H. Mitchell, was on the importance of ambulation in postoperative convalescence. A second paper was published by the same group in 1948, shortly after Doris attained her Ph.D. This research showed that encouraging surgical patients to eat earlier and to have some physical activity improved their rate of recovery. This is now common postoperative practice.

While working with the Armed Forces Food and Container Institute in Chicago, Doris and Dr. Harry Spector investigated the effect of restricted feeding on nitrogen balance. The Department of Defense was interested in this problem because of the limited feeding capability created by warfare. This work also progressed naturally from her earlier work with Professor Mitchell. Using experimental rats, Doris and Dr. Spector showed that nitrogen utilization during energy restriction was altered by dietary fat, variations in nitrogen intake and the previous diet of the individual. She continued to investigate

TABLE 1

Research topics of Professor Doris H. Calloway

Years of publication	Topic	Coauthors	Affiliation of Professor Calloway at the time of the study	Number of papers
1947–48	Convalescence and nitrogen metabolism	H.H. Mitchell, N.O. Calloway, N. Glickman	University of Chicago; University of Illinois, Urbana	2
1954–55	Energy restriction and nitrogen metabolism	H. Spector, M.I. Grossman, W.K. Calhoun	Armed Forces Food and Container Institute	4
1954–63	Irradiation of food and nutritive quality	H. Spector, M.H. Thomas, A.H. Munson	Armed Forces Food and Container Institute	5
1966–77	Gut microflora and intestinal gas; lactose intolerance	R.D. Mathews, E.L. Murphy, S.E. Burroughs, C.A. Hickey, W.L. Chenoweth, S. Meyer, M. Kretsch, L. Crawford	Stanford Research Institute; University of California, Berkeley	14
1968–70	Yeast, bacteria, and algae as food sources	S. Margen, C.I. Waslien, J. Bowering, F. Costa	University of California, Berkeley	6
1967–82	Human nitrogen and amino acid requirements	S. Margen, L.A. Weller, A.C.F. Odell, A. Yates-Zezulka, M.C. Crim, G. Butterfield-Hodgdon, E. Zanni, M.S. Kurzer	University of California, Berkeley	15
1972–82	Nutritional requirements of special groups: preschool children, pregnant and lactating women, Native Americans	S. Margen, K. Carpenter, M. Ruffin, S.H. Cohenour, J.C. King, H.N. Jacobson, M.W. Blackburn, F.M. Costa, K.K. Schraer, J.C. Gibbs, H.V. Kuhnlein, C. Geissler, N.F. Butte, O. Receveur, L. Ritchie	University of California, Berkeley	18
1976–89	Human energy requirements	M.W. Blackburn, M.S. Kurzer, S.J. Solomon, R.D. Gorsky, G. Butterfield, D.R. Garrel, K.S. Todd, E.J. Gong	University of California, Berkeley	10
1991–95	International nutrition: functional consequences of marginal nutrition	G.H. Beaton, S.P. Murphy, C. Neumann, K. Mulligan, D. Lein	University of California, Berkeley	5

protein-energy interactions throughout most of her scientific career.

Between 1957 and 1963, also while employed at the Institute for the Armed Forces in Chicago, Doris showed that irradiation did not alter the growth-promoting quality of turkey meat when it was fed to experimental animals. Irradiation decreased the thiamin content of the food, but only to the same extent as heat processing. The results of this work on the nutritional effects of irradiated food are still quoted when decisions are made to use this means of food preservation.

While at the Stanford Research Institute and during her early years at Berkeley, Doris conducted a series of studies on gut microflora and gas production. Her interest stemmed from a report that nitrogenous gases produced in the gastrointestinal track contribute to nitrogen loss in adults. She reported in *Nature* in 1966 that the intestine is not an important source of gaseous nitrogen loss, and that respiratory hydrogen, but not methane, was affected by consumption of gas-forming foods. NASA was concerned about excessive flatus production among astronauts, and this led to a long series of collaborations with the space program. She investigated the effects of various types of foods and diets on intestinal gas production, i.e., legumes, wheat-containing foods, fruits and pineapple, as well as the space diet. The widespread incidence of lactose intolerance was of concern, and in 1969, Doris reported that this disorder could be diagnosed by breath analysis. Her techniques were adopted by gastroenterologists to assist in their diagnosis and treatment of this disorder.

It was thought at NASA that hydrogen-fixing bacterium, such as *Hydrogenomonas eutropha,* could form the basis of a bioregenerative system for atmospheric control during prolonged space flight if the harvested cells could serve as a food source for the crew. Doris, therefore, studied the use of single-cell proteins, such as yeast, bacteria, and algae, as food sources. However, because these cells are high in nucleic acid, ingestion of bacteria or algae led to large quantities of uric acid production which could put the astronauts at risk for renal stones and gout.

In 1967 Doris began a systematic investigation of human nitrogen and amino acid requirements that spanned 15 years and resulted in many peer-reviewed publications, technical reports and policy documents. Her research addressed the effects of reduced protein intakes on nitrogen loss from the integument, the amount of nitrogen lost in sweat and miscellaneous losses, the amino acid patterns supporting in nitrogen balance and the adequacy of soy protein in maintaining nitrogen balance. She also studied the nitrogen requirements of pregnant, menstruating and elderly women. Her research at UC Berkeley, and that of Dr. Nevin Scrimshaw and his coworkers at MIT, served as the basis of human protein requirements and helped establish standards for intake and appropriate actions to deal with the protein-energy malnutrition existing worldwide. Doris served on the NAS/NRC Food and Nutrition Board Committee on Dietary Allowances, which established the 1969–1974 Recommended Dietary Allowances. She also served as Editor of the 1981 FAO/WHO/UNU Expert Group on Energy and Protein Requirements.

While conducting her studies of protein requirements, Doris began a series of parallel studies of human energy requirements. Much of this work focused on the energy requirements of women; she often commented on how inappropriate it was to estimate nutrient requirements of women from those of men. She did a series of studies on the energy requirements of pregnant and lactating women, which documented an increased energy need to move the heavier body during gestation. However, many years elapsed before an additional requirement for physical activity was made for pregnant women. She also studied the effects of menstruation on basal metabolic rates in women fed adequate or energy-restricted diets. In another study, Doris showed that men substituted lower effort discretionary activities for higher effort activities when food intakes were restricted by 500 kcal/d. Finally, as a result of her concerns about marginal nutrition and function (e.g., reproduction) she investigated the effect of inadequate energy intake and subsequent weight loss on sex hormones and gonadal function in men and women.

Doris also, as she said, took "occasional forays into the real-world nutrition problems." She was concerned with the consequences of insufficient food among the economically disadvantaged. She studied the food habits of Native Americans on the reservations in Arizona, the children of welfare recipients and migrant farm workers. As a participant in the 1969 White House Conference on Food, Nutrition, and Health, she compared the welfare allowances provided by each State with the cost of a diet based on the USDA Economy Food Plan and showed that the allowances were woefully inadequate. She also was critical of the federal food commodities provided to Native Americans; she documented her criticism with data on the inadequacies of the commodity foods compared with traditionally prepared foods. As early as 1975, Doris recognized that poverty increases the risk of poor functional performance, and she coauthored a paper on U.S. poverty and brain development. Clearly, Doris believed that as a nutrition scientist, she had an obligation to translate her research findings and scientific knowledge into policies and actions that would improve the functioning of the whole individual.

During the last decade of her research career, Doris focused on her fundamental concern about the functional consequences of malnutrition. She believed that human performance in a variety of areas that are important across cultures, such as disease, reproduction, cognitive function, work output, and social and behavioral habits, is related to dietary intake. To accomplish research on malnutrition and functional performance, she prepared the UCB Minilist nutrient data base with Dr. Suzanne Murphy. This database, which contained 48 nutrients for 234 food items, is still used extensively to estimate nutrient intakes in developing countries.

With funding from the U.S. Agency for International Development, Doris conceived and directed the Nutrition CRSP, the Collaborative Research Support Program on Nutrition and Human Function. The underlying basis for this project was that sustained economic development cannot occur in underdeveloped countries without improving the nutritional state of the poor. Parallel studies were conducted in Egypt, Mexico and Kenya. Results of the study showed that when total food intake is low (i.e., due to the drought in Kenya), physiologic functions are affected. Also, evidence from Kenya and Mexico showed that some essential micronutrients were at risk, especially those supplied by animal foods (i.e., iron, zinc, vitamin B-12 and vitamin B-6). Even when the food situation was reasonably satisfactory, as in Egypt, infants failed to thrive because women lacked the information to make and authority to implement better decisions regarding food choices. The Nutrition CRSP was a landmark study that provided a foundation for international food and nutrition policy. Unfortunately, many of the wrongs identified by this Study remain and, in some cases, are more serious today than when the study was done. This challenging study was done while Doris was serving as Provost of the Professional Schools and Colleges at UC Berkeley. The fact that she successfully completed the

study while being an effective administrator demonstrates her intensity, energy, commitment and integrity.

The findings from Doris's research had a substantial effect on nutrition; her work led to new concepts, which in turn led to new programs and policies. Her early work on protein metabolism provided new solutions for convalescence and wound healing; her landmark studies on protein and energy requirements provided the foundation for past and current national and international dietary standards for those nutrients; and her later work on moderate malnutrition and physiologic function led to a more comprehensive view of dietary interventions, i.e., that the quality of the food eaten is just as important as the quantity. Consequently, she substantially improved the quality of life of persons all around the world.

For these scientific contributions, Doris received all of the most notable awards in Nutrition. She was elected a Fellow of the American Institute of Nutrition and was a recipient of its prestigious Conrad Elvehjem Award. She also was elected to the NAS Institute of Medicine. She received the Bristol-Myers Squibb/Mead Johnson Award for distinguished achievement in nutrition research. Upon her retirement in 1990, she was awarded the Berkeley Citation, and in 1992, she was selected to give the UC Berkeley Faculty Research Lecture.

Her research, accomplishments and awards clearly demonstrate her outstanding work as a nutrition scientist. However, those accomplishments are not her most important contribution. As George Beaton once said, "What Doris did during her scientific career is to create a model with which others may compare themselves." It is a model of a scientist who values first truth in science and objectivity in interpretation, but who does this with perspective, i.e., who always sees the question ahead and perceives the contribution toward that more distant question. This perspective is what gave Doris's work distinction, and it is what she has given to the rest of us, individually and as a field. She had an undying faith in the importance of nutrition and a clear vision of the future. She could communicate new concepts and understandings in a way that everyone appreciated: "people eat food, not nutrients," or "if one nutrient is lacking, others are as well."

Doris, the Mentor

Doris enjoyed teaching and working with her graduate students. Her students carried out the day-to-day work while learning how to design, conduct and interpret research. Three laboratory technicians helped facilitate that learning, Delroy Brown, Fran Costa and Carol Hickey. As Suzanne Murphy said at Doris's memorial service, "As students, we knew she expected the best from us, and we somehow figured out how to become our best. She was truly an inspiration; by her example and her encouragement, we were able to exceed beyond our wildest expectations, and become 'real' nutritionists with the potential to make important contributions to our chosen field." Doris was the major advisor for 33 graduate students. Most went on to nutrition careers in other parts of the United States and the world, ranging from Hawaii to the West Coast, to Washington DC and Montreal on the East Coast, and even further east, to those now overseas.

Doris, the Administrator and Leader

Although Doris did not enjoy administration, she was Chief of the Nutrition Branch of the Armed Forces Food and Container Institute in Chicago, Chair of the Department of Food Science and Nutrition at Stanford Research Institute in Menlo Park, CA, Chair of the Department of Nutritional Sciences at UC Berkeley twice, and Provost of the Professional Schools and Colleges at UC Berkeley. She also held several leadership positions in professional societies. She was President and Secretary of the American Society for Nutritional Sciences, a member of the Executive Committees for FASEB and for the Food and Nutrition Board, and on the Advisory Councils for the National Institute of Arthritis, Metabolism, and Digestive Diseases, the National Institute on Aging, the U.S. Department of Agriculture and for the Pew National Nutrition Program.

As Provost of the Professional Schools and Colleges at UC Berkeley from 1981 to 1987, she worked diligently to give women and minorities equal chances for academic appointments. She felt diversity was extremely important and hired the first woman as Dean of the School of Public Health and the first African-American as Dean of the School of Education. She believed that proper mentoring was important for those individuals whose prior experience due to culture or other factors may not have prepared them to easily succeed. She did not accept that one's race or sex was an excuse for lesser performance, only that it could make the road more difficult.

Dr. Sally Fairfax, one of her administrative colleagues at Berkeley, said, "Doris was a person with a very special kind of leadership that was both a convincing model of what we could be and do, and a clear expectation that we would be and do it. She was willing to advocate forcefully, directly, persistently, to push the rules, and to create opportunities. Beneath her wonderful sense of humor, she was austere, sentimental, and moral."

Doris entitled her 1992 UC Berkeley Faculty Research Lecture, "Maintaining a Balance." She could not have chosen a better title to depict her commitment to balancing her scientific and administrative work with her personal values of rigor, honesty, objectivity, integrity and human equality. Doris never let the little things interfere with her vision. She taught us not to be frustrated or discouraged, but just to get on with our work. In her office, she always had a small poster that said very simply, "Hunger is Violence." She worked tirelessly to eliminate the inequities of hunger and malnutrition. The results of her efforts touched many. She leaves a legacy that will endure for decades.

ACKNOWLEDGMENTS

The author gratefully acknowledges the assistance of Kenneth Carpenter and Robert Nesheim in preparing this biography.